(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 190 158 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
06.10.2004 Bulletin 2004/41

(21) Application number: **00942227.0**

(22) Date of filing: **28.06.2000**

(51) Int Cl.[7]: **E21B 43/10**

(86) International application number:
PCT/GB2000/002514

(87) International publication number:
WO 2001/004458 (18.01.2001 Gazette 2001/03)

(54) HYDRAULIC SETTING TOOL

HYDRAULISCHES SETZGERÄT

OUTIL DE POSE HYDRAULIQUE

(84) Designated Contracting States:
DE FR GB NL

(30) Priority: **07.07.1999 US 348908**

(43) Date of publication of application:
27.03.2002 Bulletin 2002/13

(73) Proprietor: **WEATHERFORD/LAMB, INC.**
Houston Texas 77027 (US)

(72) Inventor: **ERIKSEN, Erik, Peter**
SE Calgary, Alberta T2Z 2N5 (CA)

(74) Representative: **Talbot-Ponsonby, Daniel**
Marks & Clerk
4220 Nash Court
Oxford Business Park South
Oxford OX4 2RU (GB)

(56) References cited:
US-A- 4 440 233
US-A- 4 441 560
US-A- 4 489 781
US-A- 4 598 774

Note: Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

EP 1 190 158 B1

Printed by Jouve, 75001 PARIS (FR)

Description

[0001] The present invention relates generally to oil well running tools. More specifically, the invention relates to a running tool adapted to engage a setting sleeve on a drill pipe or tubing string in a well bore, and specifically to a running tool which allows right hand rotation to be used during well bore operations and to release the setting tool from the setting sleeve.

[0002] Running tools are used for various purposes during well drilling and completion operations. For example, a running tool is typically used to set a liner hanger in a well bore. The running tool is made up in the drill pipe or tubing string between the liner hanger and the drill pipe or tubing string running to the surface. The running tool serves as a link to transmit torque to the liner hanger to place and secure the liner in the well bore. The running tool is then typically manipulated from the surface to effect release of the running tool from the liner hanger. The liner may then optionally be cemented into place in the well bore.

[0003] In a typical drill pipe or tubing string, lengths of drill pipe or tubing are connected by tool joints using right hand threads on the drill pipe. These joints are made up using right hand torque and unscrewed or released using left hand torque. Drilling is carried out by right hand or clockwise rotation of the drill string to avoid breaking out or loosening the tool joints making up the pipe string.

[0004] In one prior running tool design, connecting threads have been used to engage the running tool with the setting sleeve. In these designs, the running tool is releasable by right hand torque on the pipe string from the surface. However, this design requires holding or maintaining left hand torque on the pipe string while running into the well bore. These designs also require that the liner be set to the left in order to avoid releasing the running tool connecting threads. Because left hand torque is used to set the liner, the possibility exists that tool joints in the drill string can be unscrewed and a joint broken out.

[0005] In another prior running tool design, right hand rotation is used to both engage the liner hanger with the running tool and release the running tool from the liner hanger. Figures 1a and 1b are sectional views of a prior running tool design shown in a running-in position. The running tool 10 includes a mandrel body 12 having a threaded float nut 70 disposed on its lower end to engage a liner hanger. The running tool also includes a thrusting cap 58 having one or more latch keys 64 disposed thereon which are adapted to engage slots formed on the upper end of the liner hanger. The thrusting cap 58 is selectively engageable to the mandrel body 12 through a hydraulic assembly and a clutch assembly 19 which is engaged in the run-in position. Weight down is defined as the weight of the drill string supported on the running tool and liner hanger. The hydraulic assembly can be actuated to release the thrusting cap 58 from rotational connection with the mandrel body 12 to allow the threaded float nut 70 to be backed out of the liner hanger. The clutch assembly 19 is disengaged when the tool is in the weight down position. A torque nut 82 moves down a threaded surface of the thrusting cap 58 to re-engage the thrusting cap 58 and transmit torque imparted by the mandrel body 12 from the drill string to the thrusting cap 58.

[0006] One problem with this design is that the running tool can only be released from the liner hanger in a weight down position. The weight of the drill string causes the clutch assembly, e.g., the torque lock, to disengage from the key 78, thereby allowing relative rotation between the thrusting cap 58 and the float nut 70. This design is therefore limiting in its operation.

[0007] US 4598774 discloses a setting tool which uses a plurality of retractable, spring loaded fingers carried on a torque collar to transmit torque to a setting sleeve. The fingers can be retracted after the setting sleeve is released. A plurality of splines and a splined ring within the torque collar are used to latch the tool in the running-in position to perform wellbore operations.

[0008] US 4440233 discloses a setting tool having a mandrel and a setting nut, the mandrel being slidable between an extended running-in position and a weight set-down position.

[0009] There exists a need for a running tool which is releasable using right hand torque in any position such as weight down position, neutral position, or weight up position.

[0010] The present invention is directed to a running tool for setting a liner or other tool down hole. The running tool comprises a mandrel body, a latch assembly operably associated with the mandrel body, and a float nut carried on the mandrel body. In one aspect, the latch assembly comprises one or more dogs housed in a lock sleeve between an outer sleeve and the mandrel body and releasable under hydraulic pressure. The applied hydraulic force provides relative movement between the outer sleeve and the mandrel body, thereby releasing the dogs. A seal sub is disposed between the outer sleeve and the mandrel body and is connected to the mandrel body. The seal sub defines a fluid chamber in combination with the outer sleeve and the mandrel body. A thrusting cap connected to the lock sleeve includes one or more latch keys for engaging a setting sleeve and has a lock nut threadedly carried thereon in a passageway formed between the thrusting cap and the mandrel body.

[0011] In another aspect, the invention provides an apparatus sized and adapted for setting a liner in a well bore. The apparatus comprises a mandrel body having an upper end adapted to be connected in a pipe string and a lower end; a float nut carried on the mandrel body, the float nut having external connecting threads for engaging mating threads located on a setting sleeve; and a latch assembly operably associated with the mandrel body and having a locking member to selectively transmit relative movement between a portion of the latch as-

sembly and the mandrel body after the latch assembly has been disengaged from the mandrel body. The latch assembly is selectively connected to the mandrel body through one or more dogs and preferably comprises a hydraulically operated lock sleeve assembly to release the dogs.

[0012] In another aspect, the invention provides a running tool for use in rotating a liner hanger prior to and subsequent to setting of a liner hanger. The running tool includes a mandrel body having an upper end adapted to connect to a pipe string and a lower end adapted to connect a liner hanger; a threaded member connected to the mandrel body and adapted to connect the mandrel body to a liner hanger; and a latch key member disposed on the mandrel body selectively engageable to the mandrel body through a latch assembly and a lock assembly carried on the mandrel body. The latch assembly comprises a seal sub connected to the mandrel body; an outer sleeve disposed at least partially about the seal sub, the outer sleeve being selectively connected to the seal sub by a shear member, the seal sub, outer sleeve and mandrel body defining a chamber therebetween; and a lock sleeve rotatably locked to the mandrel body by one or more dogs disposed through the lock sleeve between the outer sleeve and the mandrel body, the lock sleeve being connected at its lower end to the thrusting cap. One or more ports connect the chamber to a bore in the mandrel body to enable fluid to flow through the mandrel body and into the chamber. The lock assembly comprises a lock nut threadedly connected to the thrusting cap and rotatably locked to the mandrel body by one or more splines.

[0013] In another aspect, a running tool for use in rotating a liner hanger prior to and subsequent to setting of the liner hanger in a well bore is provided. The running tool comprises a body defining a bore at least partially therethrough, the body having an upper internal threaded portion for connecting the body to a pipe string, an externally threaded member for connecting to a setting sleeve, a torque transmitting member to transmit torque from the body to a setting sleeve, the torque transmitting member being selectively rotatably locked or otherwise connected to the body by a latch assembly, the latch assembly comprising a lock sleeve rotatably locked or otherwise connected to the body by one or more dogs disposed at least partially therethrough and retained between the body; an outer sleeve, the dogs being releasable on movement of the outer sleeve relative to the lock sleeve; and a lock member rotatably locked or otherwise connected to the body and threadedly connected to the torque transmitting member, wherein the lock member is disposed in a passageway formed at least partially between the body and the torque transmitting member. The lock assembly further comprises a seal sub rotatably and sealably connected to the body and sealably disposed between the outer sleeve and the body; the seal sub, outer sleeve and body forming a fluid chamber therebetween having fluid communication to the bore in the body through one or more ports. The torque transmitting member is connected to the lock sleeve and the lock member.

[0014] In another aspect, a mechanical release is provided to enable operation of the tool without the assistance of hydraulic pressure. In this embodiment, a retaining sleeve is provided which is connected to the mandrel body through one or more shear pins. The retaining sleeve defines one or more recesses which house one or more dogs to prevent relative movement between the mandrel body and a locking sleeve. In a weight down position, the shear pins can be severed to disengage the retaining sleeve from the mandrel body, thus disengaging the lock sleeve.

[0015] Some preferred embodiments of the invention will now be described by way of example only and with reference to the accompanying drawings, in which:

Figures 1a and 1b are side views partially in section of a prior running tool design in a running-in position;

Figures 2a and 2b are side views partially in section of a prior running tool design in a weight down position.;

Figures 3a and 3b are side views partially in section of a running tool according to the invention in a running-in position;

Figures 4a and 4b are side views partially in section of a running tool of the invention in a release position;

Figures 5a and 5b are side views partially in section of a running tool according to the invention in a running-in position;

Figures 6a and 6b are side views partially in section of a running tool of the invention in a release position;

Figure 7 is a cross sectional view of a running tool along line 7-7;

Figure 8 is a cross sectional view of a running tool along line 8-8;

Figure 9 is a cross sectional view of a running tool along line 9-9; and

Figures 10 and 11 are side views partially in section of a running tool according to the invention.

[0016] Figures 3a and 3b are side views in partial section of a running tool 10 according to one aspect of the invention in a running-in position adapted to be made up on a pipe string for releasably engaging a setting

sleeve or liner hanger in a well bore. The invention generally includes a body 12 having a threaded connector 70, such as a float nut, disposed on its lower end and having an upper internally threaded portion 15 connectable to a pipe string (not shown). A latch assembly 17 is disposed on the body 12 to selectively transmit torque from the body 12 to at least a portion of the latch assembly 17. A lock assembly 19 is disposed at least partially between the latch assembly 17 and the body 12 to selectively transmit torque to a portion of the latch assembly when the lock assembly engages a portion of the latch assembly connected to a setting sleeve (not shown). The running tool 10 will now be described in more detail with reference to a preferred embodiment shown in Figures 3a, 3b, 4a and 4b. Figures 5a, 5b, 6a and 6b show an alternative embodiment of the invention which can be adapted to convert an existing running tool such as the tool shown in Figures 1a, 1b, 2a and 2b into a running tool of the invention. The description and numbering of Figures 5a, 5b, 6a and 6b is the same as Figures 3a, 3b, 4a and 4b and the description of the latter applies to the former.

[0017] The running tool includes a tubular mandrel body 12 having an upper end 14 which is internally threaded at the upper extent thereof for matingly engaging the external threads of the lower extent of the pipe string (not shown) running to the surface. The internally threaded upper extent 15 of the upper end of the mandrel 12 is connected through a tapered bore 16 to an internal bore 18 which runs through the remainder of the length of the mandrel body 12 to its lower end. The lower end of the mandrel body 12 has an externally threaded surface 20 adapted to be connected to a bottom sub assembly 22.

[0018] The mandrel body 12, near its upper end, has an externally threaded surface 24 which matingly engages the internally threaded surface 26 of a seal sub 28. A seal 30, such as an o-ring seal, a t-seal or other known seal, is disposed between the mandrel body 12 and the seal sub 28 at a location above the internal threaded portion 26 of the seal sub. The seal sub defines an annular channel or hydraulic chamber 32 at its upper end between the internal surface of the seal sub 28 and the mandrel body 12. A first port 34 and a second port 36 connect the annular channel or chamber 32 to the internal bore 18 running through the mandrel body 12 to enable a hydraulic fluid to be delivered into the annular channel or chamber 32 via internal bore 18.

[0019] An outer sleeve 38 is movably carried on the mandrel body and includes a seal 40 disposed at its upper end to form a sealing engagement between the mandrel body 12 and the outer sleeve 38. The outer sleeve 38 is sealingly disposed about the seal sub 28 between the inner diameter of the outer sleeve 38 and the mandrel body 12. The outer sleeve 38 is connected to the seal sub 28 via one or more shear screws 39. The seal sub 28 forms a sealing relationship between both the outer sleeve 38 via o-ring seal 42 and the mandrel body 12 to define the annular hydraulic chamber 32 at its upper end.

[0020] A lock sleeve 44 is carried on the mandrel body 12 and extends upwardly at least partially below the outer sleeve 38. One or more channels or chases 46, preferably milled slots, are provided in the upper end of the lock sleeve 44 about its circumference to receive one or more dogs 48 therein. The dogs 48 are seen more clearly in cross section in Figure 7. Preferably, a plurality of channels 46 and dogs 48, for example six, are provided. The mandrel body 12 also defines one or more recesses 50 on its outer surface to receive the dogs 48 therein when received in the channels 46 in the lock sleeve 44. The dogs 48 are retained by the outer sleeve 38 when the latch assembly is engaged and has not been released. The lock sleeve 44 and, thus, the weight of the tool and drill string are carried on a spacer 52 which is supported on a thrust bearing 54. The thrust bearing 54 is carried by an annular bearing support 56 which is carried on the upper end of a thrusting cap 58 and is supported at its lower end on the mandrel body by a snap ring 60. The thrusting cap 58 is threadedly connected to the lock sleeve 44 on a threaded shoulder 62 formed around the upper end of the thrusting cap 58. The lower end of the thrusting cap 58 includes one or more latch keys 64 which are vertically received in mating slots (not shown) formed in the upper end of the setting sleeve or liner hanger. The latch keys 64 are used to transmit torque applied to the mandrel body 12 by the pipe string to the running tool or, if attached, to the liner hanger, except during release of the running tool 10 from the liner hanger. An inwardly disposed shoulder 66 on the thrusting cap 58 provides an upper stop for a coil spring 68 housed below the thrusting cap 58 and disposed around the mandrel body. The seal sub 28, the outer sleeve 38, the lock sleeve 44, dogs 48 and thrusting cap 58 comprise the latch assembly 17.

[0021] A float nut 70 is carried on the lower end of the mandrel body 12 and includes external threads 72 disposed on its outer surface. The external threads 72 are adapted to be received by the setting sleeve and are preferably left handed (or counter clockwise) threads. The upper surface 74 of the float nut 70 provides a lower support for the coil spring 68. The float nut 70 supports the spring between its upper surface 74 and the lower surface of the shoulder 66 of the thrusting cap 58. The float nut 70 defines four axial channels 76 which receive four splines 78 that fix the rotation of the float nut to the mandrel body while allowing vertical movement therealong. While four splines are preferred, any number could be used depending on the application. The splines 78 are also received at least partially in the mandrel body and prevent relative movement between the float nut 70 and the mandrel body 12 as shown in Figure 8. Figure 8 is a cross sectional view through the running tool at the location of the float nut 70 showing the relationship between the float nut 70, the mandrel body 12 and the splines 78. Four corresponding channels 80 are

formed in the mandrel body 12 along the length of the mandrel body 12 at its lower end to receive the splines 78.

[0022] Referring again to Figures 3a and 3b, and the cross section of Figure 9, a lock nut 82 is disposed between the thrusting cap 58 and the mandrel body 12 in an axial passageway 84 formed therebetween. The lock nut 82 is carried on the splines 78 to prevent relative rotational movement between the lock nut 82, the mandrel body 12 and the float nut 70. The outer surface 83 of the lock nut 82 is threaded and engages an inner threaded surface 85 of the thrusting cap 58. The outer threads on the lock nut 82 and internal surface of the thrusting cap 58 preferably have a finer pitch than the threads on the float nut 70 and the setting sleeve, are opposite in direction to those on the float nut 70 and are greater in number than those on the float nut 70. The difference in pitch enables greater vertical displacement of the float nut 70 compared to the lock nut 82 per rotation. The lock nut 82 travels down the internally threaded surface 85 of the thrusting cap on relative rotation between the mandrel body 12 and the thrusting cap 58. Thus, the float nut 70 can be disengaged from the liner hanger before the lock nut 82 bottoms out in the axial passageway 84 when it contacts the upper surface of the shoulder 66 on the thrusting cap 58. When this contact is made, the mandrel body 12 can again transmit torque to the thrusting cap 58 and to the setting sleeve and liner hanger if attached to the thrusting cap 58. The lock nut 82 and splines 78 comprise a lock assembly to transmit torque from the mandrel body 12 to the thrusting cap 58 when the lock nut moves into abutting relationship with thrusting cap 58.

[0023] The operation of the running tool will now be described in more detail in a right hand rotation run in application. While right hand rotation is preferred, left hand rotation could also be used. In operation, the running tool is made up and run into the well bore hole while maintaining right hand rotation on the pipe string. When the running tool and liner hanger have reached the desired depth, a hydraulic fluid is pumped into the bore of the pipe string or tubing string behind a plug, such as a ball, which could be disposed at the lower end of the liner supported below the setting sleeve. Hydraulic fluid flows from the bore in the drill pipe or tubing string and through the ports 34, 36 into the annular hydraulic chamber 32 as the pressure in the pipe string bore is increased. As the pressure in the hydraulic chamber 32 increases, the shear screw 39 securing the outer sleeve 38 to the seal sub 28 shears and the pressure in the annular chamber forces the outer sleeve 38 up the mandrel body 12. As the outer sleeve travels up the mandrel body, the dogs 48 disposed in the channels and recesses 46, 50 formed between the mandrel body and the lock sleeve 44 are released and move outwardly under the torque exerted through the mandrel body 12. Once the dogs 48 are released, the torque on the drill string is transmitted through the mandrel body 12 to the float nut 70 and the lock nut 82. Torque is not transmitted through the lock sleeve 44 and thrusting cap 58 once the dogs 48 are released until the lock nut 82 travels down the threaded surface of the thrusting cap 58 and bottoms out in the passageway 84 on the upper surface of the shoulder 66. On continued right hand rotation, the float nut 70 backs out of the setting sleeve or liner hanger to release the float nut 70 from the liner hanger. On further continued rotation, the lock nut 82 travels down the threaded surface of the thrusting cap 58 until the lock nut 82 bottoms out along the upper surface of the annular shoulder 66 of the thrusting cap 58. Once the lock nut bottoms out, the torque transmitted through the mandrel body 12 is again transmitted to the thrusting cap 58 to provide rotation to the liner hanger during subsequent procedures, such as cementing the liner in place in the well bore. On completion of the subsequent process, the running tool can be removed from the well bore on the end of the pipe string, leaving the liner in place.

[0024] In another embodiment shown in Figures 10 and 11, a safety release can be provided which is mechanically operable without the assistance of hydraulic pressure. In this embodiment, one or more shear pins or set screws 101, 103, 105 (three shown in Figure 10) are provided to connect an annular retaining sleeve 107 to the mandrel body. The recesses 50 which house the dogs 48 (shown in Figure 11), formed as a part of the mandrel body 12 in embodiments described above, are disposed in the annular retaining sleeve 107. Preferably eighteen shear pins connect the annular retaining sleeve to the mandrel body. The retaining sleeve 107 rides on the thrust bearing 54. The shear pins 101, 103, 105 connect the retaining sleeve 107 to the mandrel body to prevent rotational and linear (axial) movement between the retaining sleeve and the mandrel body 12. On standard operation, hydraulic fluid is delivered as described above and the dogs are released as the outer sleeve moves up the mandrel body. However, should the inlets to the source of hydraulic fluid become clogged or should hydraulic fluid otherwise be prevented from operating the releasing mechanisms of the tool, a weight down position of the tool will shear the pins 101, 103, 105 and disengage retaining sleeve 107 from the mandrel body, and thus disengage the dogs 48 and the lock sleeve 44 from the mandrel body 12. In addition, a pre-determined right or left hand torque alone or in combination with a weight down position could be used to shear the pins connecting the annular retaining sleeve to the mandrel body.

[0025] Three channels 109, 111, 113 are formed in the mandrel body 12 to receive the shear pins 101, 103, 105. Preferably, the channels are sized and adapted to enable the pins to be sheared independently in sequence. When the dogs are held in the recesses 50, the lock sleeve 44 is rotationally locked to the retaining sleeve andthe mandrel body 12. Afterthe device is set downhole, continued downward movement of the man-

drel body causes relative vertical movement between the mandrel body and the retaining sleeve locked to the mandrel body by the shear pins and to the lock sleeve 44 by the dogs 48. In the embodiment shown, as the mandrel body continues downward movement relative to the lock sleeve 44, the lower pin 101 is sheared. As the mandrel body 12 continues downward under its weight, the second pin 103 moves in the second channel 111 until the second pin contacts the upper edge of the second channel 111. The second pin 103 is then sheared on continued movement of the mandrel body downward relative to the lock sleeve 44. On further movement of the mandrel body down hole, the third pin 105 contacts the upper edge of the third channel 113 and is sheared.

[0026] While the foregoing is directed to preferred embodiments of the present invention, other and further embodiments of the invention may be devised without departing from the basic scope thereof. The scope of the invention is determined by the claims which follow.

Claims

1. An apparatus sized and adapted for setting a liner in a well bore, comprising:

a mandrel body (12) having an upper end (14) adapted to be connected in a pipe string and a lower end;
a float nut (70) carried on the mandrel body (12), the float nut (70) having external connecting threads (72) for engaging material threads located on a setting sleeve;
a latch assembly (17) operably associated with the mandrel body (12) and configured to restrict axial and rotational movement relative to the mandrel body (12) before being disengaged; and **characterised in that** it comprises
a locking member disposed between the latch assembly (17) and the mandrel body (12) and floating axially along a length of the mandrel body (12) while being constrained against rotational movement relative to the mandrel body (12); wherein, upon application of torque to the mandrel body (12) and without placing the apparatus in a weigh down position, the locking member is adapted to selectively transmit the torque between a portion of the latch assembly (17) and the mandrel body (12) after the latch assembly (17) has been disengaged from the mandrel body (12); and
further **characterised in that** the latch assembly (17) is selectively connected to the mandrel body (12) through one or more dogs (48).

2. Apparatus as claimed in claim 1, wherein the lock sleeve assembly comprises:

a seal sub (28) sealably connected to the mandrel body (12) and an outer sleeve (38) sealably disposed about the seal sub and the mandrel body and connected to the seal sub through one or more shear screws (39), and wherein the mandrel body, the seal sub and the outer sleeve define a chamber (32) connected to a fluid source; and
a lock sleeve (44) disposed at least partially between the mandrel body and the outer sleeve.

3. Apparatus as claimed in claim 2, wherein the latch assembly (17) further comprises a thrusting cap (58) connected to the lock sleeve (44) wherein the thrusting cap at least partially comprises one or more latch keys (64) for selectively connecting to a setting sleeve.

4. Apparatus as claimed in claim 3, wherein the locking member comprises a lock nut (82) having external threads (83) thereon which are threadedly engaged to the thrusting cap (58) to transmit torque upon a selected amount of rotation.

5. Apparatus as claimed in claim 4, wherein the external threads (83) of the lock nut (82) are opposite in direction to the external threads (72) on the float nut (70).

6. Apparatus as claimed in claim 4 or 5, wherein the external threads (83) of the lock nut (82) have a finer pitch than the external threads (72) on the float nut (70).

7. Apparatus as claimed in any preceding claim, further comprising a retaining sleeve (107) connected to the mandrel body (12) and defining one or more recesses (50) into which one or more dogs (48) can be disposed.

8. Apparatus as claimed in claim 7, wherein the retaining sleeve (107) is connected to the mandrel body (12) by one or more shear pins (101, 103, 105).

9. Apparatus as claimed in claim 8, wherein the mandrel body (12) defines two or more channels (109, 111, 113) which receive a shear pin (101, 103, 105) therein and are sized and adapted to enable independent shear of each shear pin.

10. A running tool for use in rotating a liner hanger prior to and subsequent to setting of a liner hanger, comprising:

(a) a mandrel body (12) having an upper end (14) adapted to connect to a pipe string and a lower end adapted to connect to a liner hanger;
(b) a threaded member (70) connected to the

mandrel body and adapted to connect the mandrel body to a liner hanger; and
(c) a latch key member disposed on the mandrel body (12) selectively engageable to the mandrel body through a latch assembly (17) and a lock assembly carried on the mandrel body,

characterised in that the latch assembly (17) comprises a lock sleeve (44) rotatably locked to the mandrel body by one or more dogs (48) disposed through the lock sleeve between an outer sleeve (38) and the mandrel body.

11. A running tool as claimed in claim 10, wherein the latch key member partially comprises a thrusting cap (58).

12. A running tool as claimed in claim 11, wherein the latch assembly (17) comprises:

a seal sub (28) connected to the mandrel body (12);
an outer sleeve (38) disposed at least partially about the seal sub, the outer sleeve being selectively connected to the seal sub by a shear member (39), the seal sub, outer sleeve and mandrel body defining a chamber (32) therebetween;
and wherein the lock sleeve is connected at its lower end to the thrusting cap.

13. A running tool as claimed in claim 12, further comprising one or more ports (34), (36) connected to the chamber (32) and to a bore (18) in the mandrel body to enable fluid to flow through the mandrel body and into the chamber.

14. A running tool as claimed in claim 12 or 13, wherein the lock sleeve (44) is supported on a bearing (54) carried on the mandrel body between the lock sleeve (44) and the thrusting cap (58).

15. A running tool as claimed in any of claims 11 to 14, wherein the lock assembly comprises a lock nut (82) threadedly connected to the thrusting cap (58) and rotationally locked to the mandrel body (12) by one or more splines (78).

16. A running tool as claimed in claim 10, wherein the mandrel body (12) definines a bore (18) at least partially therethrough, the upper end (14) comprises an upper internal threaded portion for connecting the body (12) to the pipe string, the threaded member (70) comprises an externally threaded member, the liner hanger comprises a setting sleeve, the latch key member comprises a torque transmitting member to transmit torque from the body (12) to the setting sleeve, the torque transmitting member being selectively rotatably locked to the body by the lock assembly, and the latch assembly comprises:

the lock sleeve (44) rotatably locked to the body (12) by one or more dogs (48) disposed at least partially therethrough and retained with respect to the body;
the outer sleeve (38), the dogs being releasable on movement of the outer sleeve (38) relative to the lock sleeve (44); and
a lock member rotatably locked to the body and threadedly connected to the torque transmitting member, wherein the lock member is disposed in a passageway formed at least partially between the body and the torque transmitting member.

17. A running tool as claimed in claim 16, wherein the lock assembly further comprises a seal sub (28) rotatably locked and sealably connected to the body (12) and sealably disposed between the outer sleeve (38) and the body; the seal sub, outer sleeve and body forming a fluid chamber (32) therebetween having fluid communication to the bore in the body through one or more ports (34, 36).

18. A running tool as claimed in claim 16 or 17, wherein the torque transmitting member is connected to the lock sleeve (44) and the lock member.

19. A running tool as claimed in claim 16, 17 or 18, wherein the lock sleeve (44) is carried on a bearing assembly carried on the body.

Patentansprüche

1. Vorrichtung, die für das Setzen eines Liners in ein Bohrloch bemessen und ausgeführt ist, die aufweist:

einen Mantelrohrkörper (12) mit einem oberen Ende (14), das ausgeführt ist, damit es mit einem Rohrstrang verbunden werden kann, und einem unteren Ende;
eine frei bewegliche Mutter (70), die auf dem Mantelrohrkörper (12) getragen wird, wobei die frei bewegliche Mutter (70) Außengewindegänge (72) für einen Eingriff in substantielle Gewindegänge, die auf einer Setzhülse angeordnet sind, aufweist;
eine Einklinkbaugruppe (17), die funktionell mit dem Mantelrohrkörper (12) verbunden und so konfiguriert ist, daß eine axiale und Drehbewegung relativ zum Mantelrohrkörper (12) eingeschränkt wird, bevor sie getrennt wird; und **dadurch gekennzeichnet, daß** sie

ein Sperrelement aufweist, das zwischen der Einklinkbaugruppe (17) und dem Mantelrohrkörper (12) angeordnet und axial entlang einer Länge des Mantelrohrkörpers (12) frei beweglich ist, während es gegen eine Drehbewegung relativ zum Mantelrohrkörper (12) eingeschränkt wird; worin bei Anwendung des Drehmomentes auf den Mantelrohrkörper (12) und ohne Anordnen der Vorrichtung in einer Niederdrückposition das Sperrelement so ausgeführt ist, daß es selektiv das Drehmoment zwischen einem Abschnitt der Einklinkbaugruppe (17) und dem Mantelrohrkörper (12) überträgt, nachdem die Einklinkbaugruppe (17) vom Mantelrohrkörper (12) getrennt wurde; und
außerdem **dadurch gekennzeichnet, daß** die Einklinkbaugruppe (17) selektiv mit dem Mantelrohrkörper (12) mittels eines oder mehrerer Mitnehmer (48) verbunden wird.

2. Vorrichtung nach Anspruch 1, bei der die Sperrhülsenbaugruppe aufweist:

eine Dichtungsunterbaugruppe (28), die abdichtbar mit dem Mantelrohrkörper (12) und einer äußeren Hülse (38) verbunden ist, die abdichtbar um die Dichtungsunterbaugruppe und den Mantelrohrkörper angeordnet und mit der Dichtungsunterbaugruppe mittels einer oder mehrerer Scherschrauben (39) verbunden ist, und bei der der Mantelrohrkörper, die Dichtungsunterbaugruppe und die äußere Hülse eine Kammer (32) definieren, die mit einer Fluidquelle verbunden ist; und
eine Sperrhülse (44), die zumindestens teilweise zwischen dem Mantelrohrkörper und der äußeren Hülse angeordnet ist.

3. Vorrichtung nach Anspruch 2, bei der die Einklinkbaugruppe (17) außerdem eine Druckkappe (58) aufweist, die mit der Sperrhülse (44) verbunden ist, wobei die Druckkappe mindestens teilweise einen oder mehrere Einklinkkeile (64) für das selektive Verbinden mit einer Setzhülse aufweist.

4. Vorrichtung nach Anspruch 3, bei der das Sperrelement eine Sperrmutter (82) mit Außengewindegängen (83) darauf aufweist, die verschraubbar mit der Druckkappe (58) in Eingriff gebracht werden, um das Drehmoment bei einem ausgewählten Grad der Drehung zu übertragen.

5. Vorrichtung nach Anspruch 4, bei der die Außengewindegänge (83) der Sperrmutter (82) in der Richtung den Außengewindegängen (72) auf der frei beweglichen Mutter (70) entgegengesetzt sind.

6. Vorrichtung nach Anspruch 4 oder 5, bei der die Außengewindegänge (83) der Sperrmutter (82) eine feinere Steigung als die Außengewindegänge (72) auf der frei beweglichen Mutter (70) aufweisen.

7. Vorrichtung nach einem der vorhergehenden Ansprüche, die außerdem eine Haltehülse (107) aufweist, die mit dem Mantelrohrkörper (12) verbunden ist und eine oder mehrere Aussparungen (50) definiert, in denen ein oder mehrere Mitnehmer (48) angeordnet werden können.

8. Vorrichtung nach Anspruch 7, bei der die Haltehülse (107) mit dem Mantelrohrkörper (12) mittels eines oder mehrerer Scherbolzen (101, 103, 105) verbunden ist.

9. Vorrichtung nach Anspruch 8, bei der der Mantelrohrkörper (12) zwei oder mehrere Kanäle (109, 111, 113) definiert, die einen Scherbolzen (101, 103, 105) darin aufnehmen und so bemessen und ausgeführt sind, daß sie ein unabhängiges Scheren eines jeden Scherbolzens ermöglichen.

10. Einfahrwerkzeug für eine Verwendung beim Drehen eines Linerhängers vor dem und anschließend an das Setzen eines Linerhängers, das aufweist:

(a) einen Mantelrohrkörper (12) mit einem oberen Ende (14), das so ausgeführt ist, daß es mit einem Rohrstrang verbunden werden kann, und einem unteren Ende, das so ausgeführt ist, daß es mit einem Linerhänger verbunden wird;
(b) ein Gewindelement (70), das mit dem Mantelrohrkörper verbunden wird und so ausgeführt ist, daß es den Mantelrohrkörper mit einem Linerhänger verbindet; und
(c) ein Einklinkkeilelement, das am Mantelrohrkörper (12) angeordnet ist, um selektiv mit dem Mantelrohrkörper mittels einer Einklinkbaugruppe (17) und einer Sperrbaugruppe, die am Mantelrohrkörper getragen wird, in Eingriff kommen zu können;

dadurch gekennzeichnet, daß die Einklinkbaugruppe (17) eine Sperrhülse (44) aufweist, die drehbar am Mantelrohrkörper mittels eines oder mehrerer Mitnehmer (48) verriegelt wird, der mittels der Sperrhülse zwischen einer äußeren Hülse (38) und dem Mantelrohrkörper angeordnet wird.

11. Einfahrwerkzeug nach Anspruch 10, bei dem das Einklinkkeilelement teilweise eine Druckkappe (58) aufweist.

12. Einfahrwerkzeug nach Anspruch 11, bei dem die Einklinkbaugruppe (17) aufweist:

eine Dichtungsunterbaugruppe (28), die mit

dem Mantelrohrkörper (12) verbunden ist;
eine äußere Hülse (38), die mindestens teilweise um die Dichtungsunterbaugruppe angeordnet ist, wobei die äußere Hülse selektiv mittels eines Scherelementes (39) mit der Dichtungsunterbaugruppe verbunden wird, wobei die Dichtungsunterbaugruppe, die äußere Hülse und der Mantelrohrkörper eine Kammer (32) dazwischen definieren;
und worin die Sperrhülse an ihrem unteren Ende mit der Druckkappe verbunden ist.

13. Einfahrwerkzeug nach Anspruch 12, das außerdem eine oder mehrere Öffnungen (34), (36) aufweist, die mit der Kammer (32) und mit einer Bohrung (18) im Mantelrohrkörper verbunden sind, damit Fluid durch den Mantelrohrkörper und in die Kammer hinein fließen kann.

14. Einfahrwerkzeug nach Anspruch 12 oder 13, bei dem die Sperrhülse (44) auf einem Lager (54) getragen wird, das am Mantelrohrkörper zwischen der Sperrhülse (44) und der Druckkappe (58) getragen wird.

15. Einfahrwerkzeug nach einem der Ansprüche 11 bis 14, bei dem die Sperrbaugruppe eine Sperrmutter (82) aufweist, die verschraubbar mit der Druckkappe (58) verbunden und mittels einer oder mehrerer Paßfedern (78) drehbar mit dem Mantelrohrkörper (12) verriegelt ist.

16. Einfahrwerkzeug nach Anspruch 10, bei dem der Mantelrohrkörper (12) eine Bohrung (18) zumindestens teilweise dort hindurch definiert, das obere Ende (14) einen oberen Innengewindeabschnitt für das Verbinden des Körpers (12) mit dem Rohrstrang aufweist, das Gewindeelement (70) ein Außengewindeelement aufweist, der Linerhänger eine Setzhülse aufweist, das Einklinkkeilelement ein Drehmomentübertragungselement aufweist, um das Drehmoment vom Körper (12) auf die Setzhülse zu übertragen, wobei das Drehmomentübertragungselement selektiv drehbar mit dem Körper mittels der Sperrbaugruppe verriegelt wird, und die Einklinkbaugruppe aufweist:

die Sperrhülse (44), die drehbar mit dem Körper (12) mittels eines oder mehrerer Mitnehmer (48) verriegelt ist, der mindestens teilweise dort hindurch angeordnet und mit Bezugnahme auf den Körper festgehalten wird;
die äußere Hülse (38), wobei die Mitnehmer bei Bewegung der äußeren Hülse (38) relativ zur Sperrhülse (44) freigegeben werden können; und
ein Sperrelement, das drehbar mit dem Körper verriegelt und verschraubbar mit dem Drehmomentübertragungselement verbunden ist, worin das Sperrelement in einem Durchgang angeordnet wird, der mindestens teilweise zwischen dem Körper und dem Drehmomentübertragungselement gebildet wird.

17. Einfahrwerkzeug nach Anspruch 16, bei dem die Sperrbaugruppe außerdem eine Dichtungsunterbaugruppe (28) aufweist, die mit dem Körper (12) drehbar verriegelt und abdichtbar verbunden wird, und die abdichtbar zwischen der äußeren Hülse (38) und dem Körper angeordnet ist; wobei die Dichtungsunterbraugruppe, die äußere Hülse und der Körper, die eine Fluidkammer (32) dazwischen bilden, eine Fluidverbindung zur Bohrung im Körper durch eine oder mehrere Öffnungen (34, 36) aufweisen.

18. Einfahrwerkzeug nach Anspruch 16 oder 17, bei dem das Drehmomentübertragungselement mit der Sperrhülse (44) und dem Sperrelement verbunden ist.

19. Einfahrwerkzeug nach Anspruch 16, 17 oder 18, bei dem die Sperrhülse (44) auf einer Lagerbaugruppe getragen wird, die am Körper getragen wird.

Revendications

1. Dispositif dimensionné et destine à poser une colonne perdue dans un puits de forage, comprenant:

un corps de mandrin (12), comportant une extrémité supérieure (14), destinée à être connectée dans un train de tubes, et une extrémité inférieure;

un écrou flottant (70) supporté sur le corps du mandrin (12), l'écrou flottant (70) comportant des filetages de connexion externes (72) destinés à s'engager dans des filetages de matériau agencés sur un manchon de pose;

un assemblage de verrouillage (17) associé en service au corps du mandrin (12) et destiné à limiter le déplacement axial et par rotation par rapport au corps du mandrin (12) avant son dégagement; et **caractérisé en ce qu'**il comprend

un élément de blocage agencé entre l'assemblage de verrouillage (17) et le corps du mandrin (12) et flottant axialement le long d'une longueur du corps du mandrin (12), son déplacement par rotation par rapport au corps du mandrin (12) étant empêché; lors de l'application d'un couple au corps du mandrin (12), sans pla-

cer le dispositif dans une position de blocage vers le bas, l'élément de blocage est adapté pour transmettre sélectivement le couple entre une partie de l'assemblage de verrouillage (17) et le corps du mandrin (12) après le dégagement de l'assemblage de verrouillage (17) du corps du mandrin (12); et

caractérisé en outre en ce que l'assemblage de verrouillage (17) est connecté sélectivement au corps du mandrin (12) par l'intermédiaire d'une ou de plusieurs griffes (48).

2. Dispositif selon la revendication 1, dans lequel l'assemblage de manchon de blocage comprend:

une réduction de tiges d'étanchéité (28) connectée de manière étanche au corps du mandrin (12) et un manchon externe (38) agencé de manière étanche autour de la réduction de tiges d'étanchéité et du corps du mandrin et connecté à la réduction de tiges d'étanchéité par une ou plusieurs vis de cisaillement (39), le corps du mandrin, la réduction de tiges d'étanchéité et le manchon externe définissant une chambre (32) connectée à une source de fluide; et

un manchon de verrouillage (44) agencé au moins partiellement entre le corps du mandrin et le manchon externe.

3. Dispositif selon la revendication 2, dans lequel l'assemblage de verrouillage (17) comprend en outre un capuchon de poussée (58) connecté au manchon de blocage (44), le capuchon de poussée comprenant au moins partiellement une ou plusieurs clavettes de verrouillage (64) destinées à être connectées sélectivement à un manchon de pose.

4. Dispositif selon la revendication 3, dans lequel l'élément de blocage comprend un écrou de blocage (82) comportant des filetages externes (83) engagés par filetage dans le capuchon de poussée (58) pour transmettre le couple en présence d'une distance de rotation sélectionnée.

5. Dispositif selon la revendication 4, dans lequel les filetages externes (83) de l'écrou de blocage (82) ont une direction opposée à celle des filetages externes (72) sur l'écrou flottant (70).

6. Dispositif selon les revendications 4 ou 5, dans lequel les filetages externes (83) de l'écrou de blocage (82) ont un pas plus fin que les filetages externes (72) sur l'écrou flottant (70).

7. Dispositif selon l'une quelconque des revendications précédentes, comprenant en outre un manchon de retenue (107) connecté au corps du mandrin (12) et définissant un ou plusieurs évidements dans lesquels peuvent être agencées une ou plusieurs griffes (48).

8. Dispositif selon la revendication 7, dans lequel le manchon de retenue (107) est connecté au corps du mandrin (12) par une ou plusieurs goupilles de cisaillement (101, 103, 105).

9. Dispositif selon la revendication 8, dans lequel le corps du mandrin (12) définit deux ou plusieurs canaux (109, 111, 113) recevant une goupille de cisaillement (101, 103, 105) et dimensionnés et configurés de sorte à permettre un cisaillement indépendant de chaque goupille de cisaillement.

10. Outil de descente destiné à faire tourner une suspension de colonne perdue avant et après la pose d'une suspension de colonne perdue, comprenant:

(a) un corps de mandrin (12) comportant une extrémité supérieure (14), destinée à être connectée à un train de tubes, et une extrémité inférieure destinée à être connectée à une suspension de colonne perdue;
(b) un élément fileté (70) connecté au corps du mandrin et destiné à connecter le corps du mandrin à une suspension de colonne.perdue; et
(c) un élément de clavette de verrouillage agencé sur le corps du mandrin (12), pouvant être engagé sélectivement dans le corps du mandrin par l'intermédiaire d'un assemblage de verrouillage (17) et d'un assemblage de blocage supportés sur le corps du mandrin,

caractérisé en ce que l'assemblage de verrouillage (17) comprend un manchon de blocage (44) bloqué par rotation sur le corps du mandrin par une ou plusieurs griffes (48) agencées à travers le manchon de blocage entre un manchon externe (38) et le corps du mandrin.

11. Outil de descente selon la revendication 10, dans lequel l'élément de clavette de verrouillage comprend partiellement un capuchon de poussée (58).

12. Outil de descente selon la revendication 11, dans lequel l'assemblage de verrouillage (17) comprend:

une réduction de tiges d'étanchéité (28) connectée au corps du mandrin (12);

un manchon externe (38) agencé au moins partiellement autour de la réduction de tiges

d'étanchéité, le manchon externe étant connecté sélectivement à la réduction de tiges d'étanchéité par un élément de cisaillement (39), la réduction de tiges d'étanchéité, le manchon externe et le corps du mandrin définissant une chambre (32) entre eux;

le manchon de blocage étant connecté au niveau de son extrémité inférieure au capuchon de poussée.

13. Outil de descente selon la revendication 12, comprenant en outre un ou plusieurs orifices (34), (36), connectés à la chambre (32) et à un alésage (18) dans le corps du mandrin pour permettre un écoulement du fluide à travers le corps du mandrin et dans la chambre.

14. Outil de descente selon les revendications 12 ou 13, dans lequel le manchon de blocage (44) est supporté sur un palier (54) supporté sur le corps du mandrin entre le manchon de blocage (44) et le capuchon de poussée (58).

15. Outil de descente selon l'une quelconque des revendications 11 à 14, dans lequel l'assemblage de blocage comprend un écrou de blocage (82), connecté par filetage sur un capuchon de poussée (58) et bloqué par rotation sur le corps du mandrin (12) par une ou plusieurs cannelures (78).

16. Outil de descente selon la revendication 10, dans lequel le corps du mandrin (12) définit un alésage (18) le traversant au moins partiellement, l'extrémité supérieure (14) comprenant une partie supérieure à filetage interne pour connecter le corps (12) à un train de tubes, l'élément fileté (70) comprenant un élément à filetage externe, la suspension de colonne perdue comprenant un manchon de pose, l'élément de clavette de verrouillage comprenant un élément de transmission du couple, destiné à transmettre le couple du corps (12) vers le manchon de pose, l'élément de transmission du couple étant sélectivement bloqué par rotation sur le corps par l'assemblage de blocage, et l'assemblage de verrouillage comprenant:

le manchon de blocage (44) bloqué par rotation sur le corps (12) par une ou plusieurs griffes (48) le traversant au moins partiellement et retenus par rapport au corps;

le manchon externe (38), les griffes pouvant être dégagées lors du déplacement du manchon externe (38) par rapport au manchon de blocage (44); et

un élément de blocage, bloqué par rotation sur le corps et connecté par filetage à l'élément de transmission du couple, l'élément de blocage étant agencé dans un passage formé au moins partiellement entre le corps et l'élément de transmission du couple.

17. Outil de descente selon la revendication 16, dans lequel l'assemblage de blocage comprend en outre une réduction de tiges d'étanchéité (28) bloquée en rotation et connectée de manière étanche au corps (12) et agencée de manière étanche entre le manchon externe (38) et le corps; la réduction de tiges d'étanchéité, le manchon externe et le corps formant une chambre de fluide (32) entre eux, en communication de fluide avec l'alésage dans le corps par l'intermédiaire d'un ou de plusieurs orifices (34, 36).

18. Outil de descente selon les revendications 16 ou 17, dans lequel l'élément de transmission du couple est connecté au manchon de blocage (44) et à l'élément de blocage.

19. Outil de descente selon les revendications 16, 17 ou 18, dans lequel le manchon de blocage (44) est supporté sur un assemblage de palier supporté sur le corps.

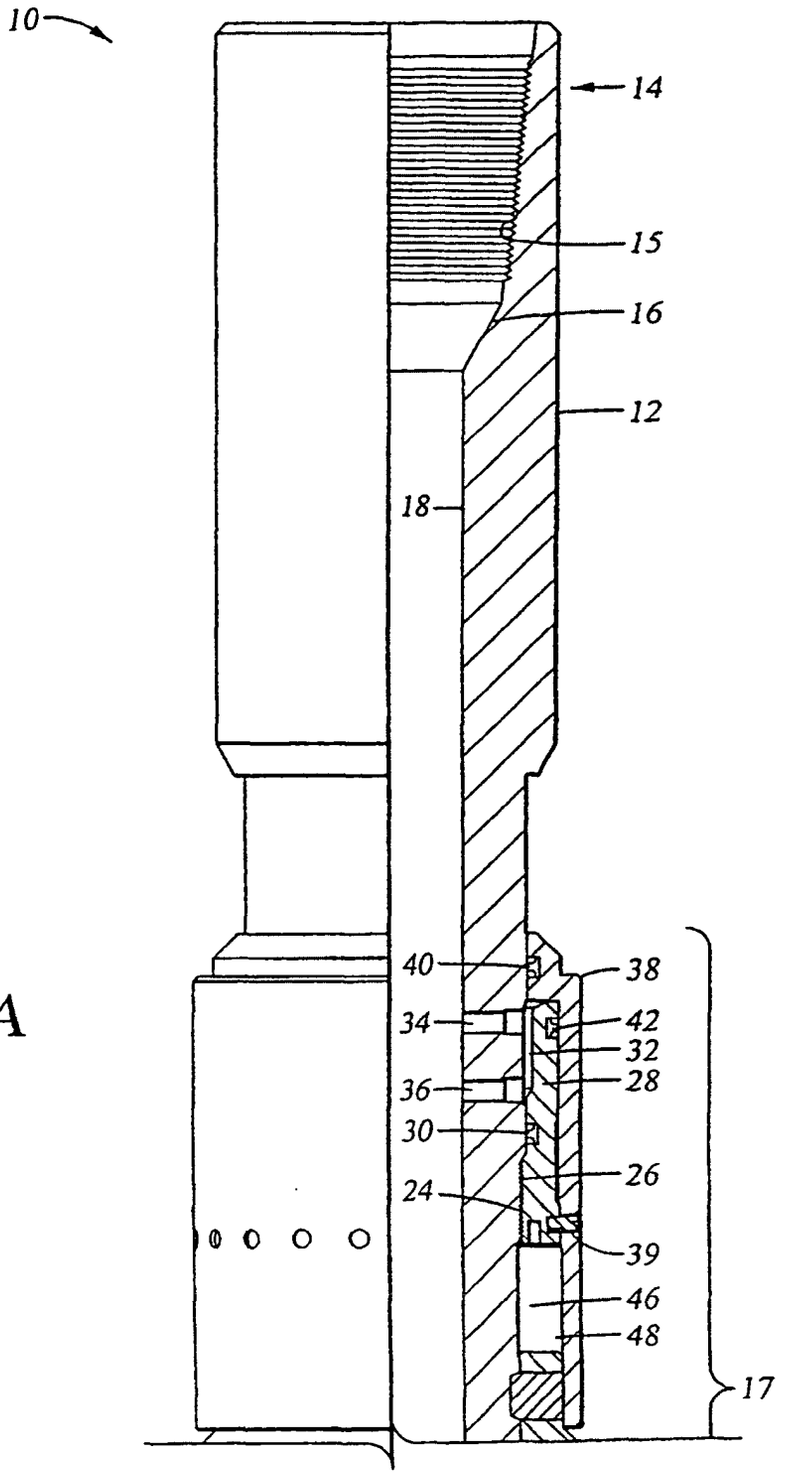


Fig. 1A
(PRIOR ART)

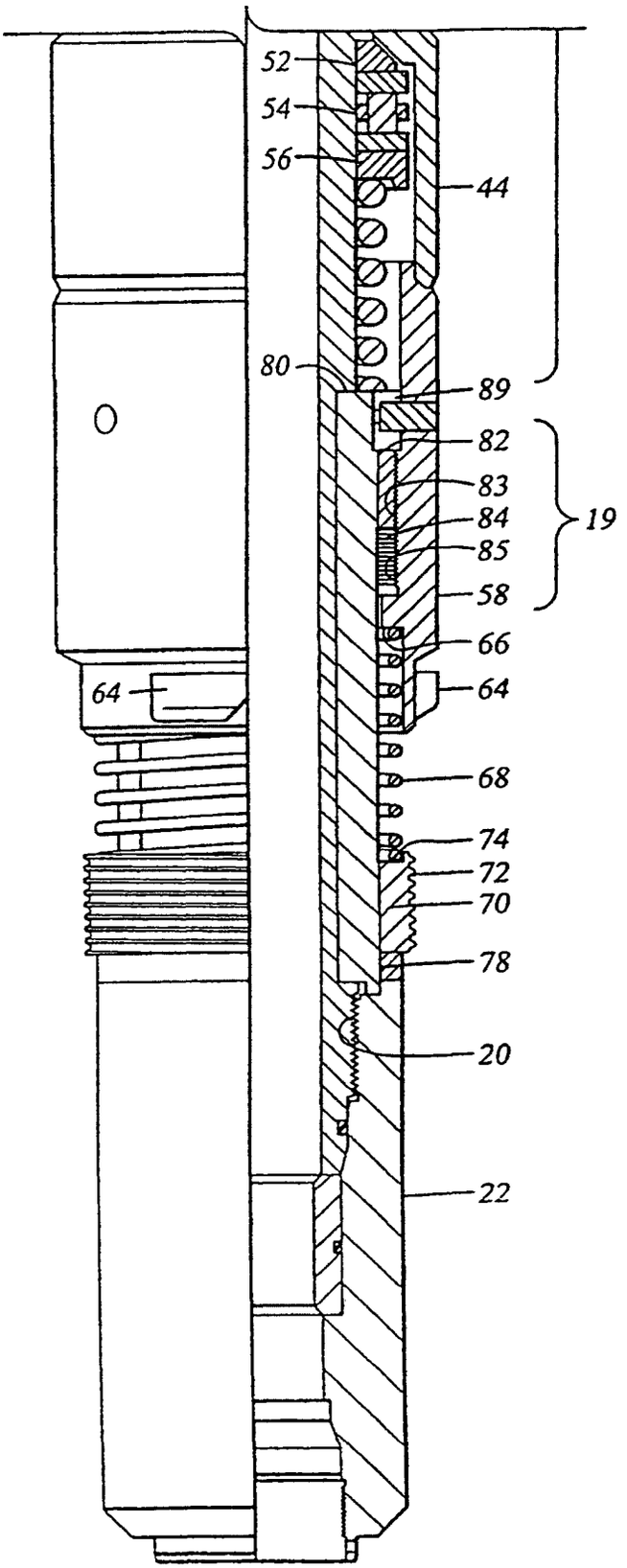


Fig. 1B
(PRIOR ART)

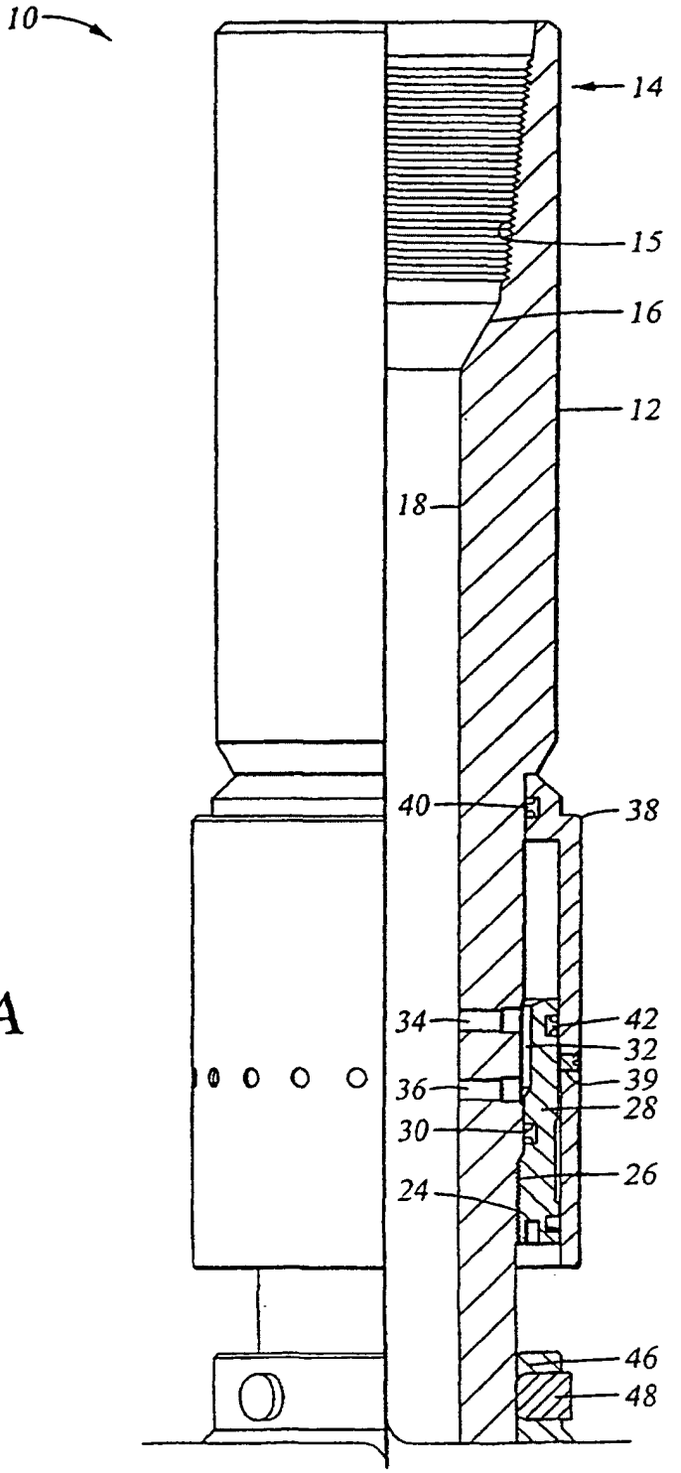


Fig. 2A
(PRIOR ART)

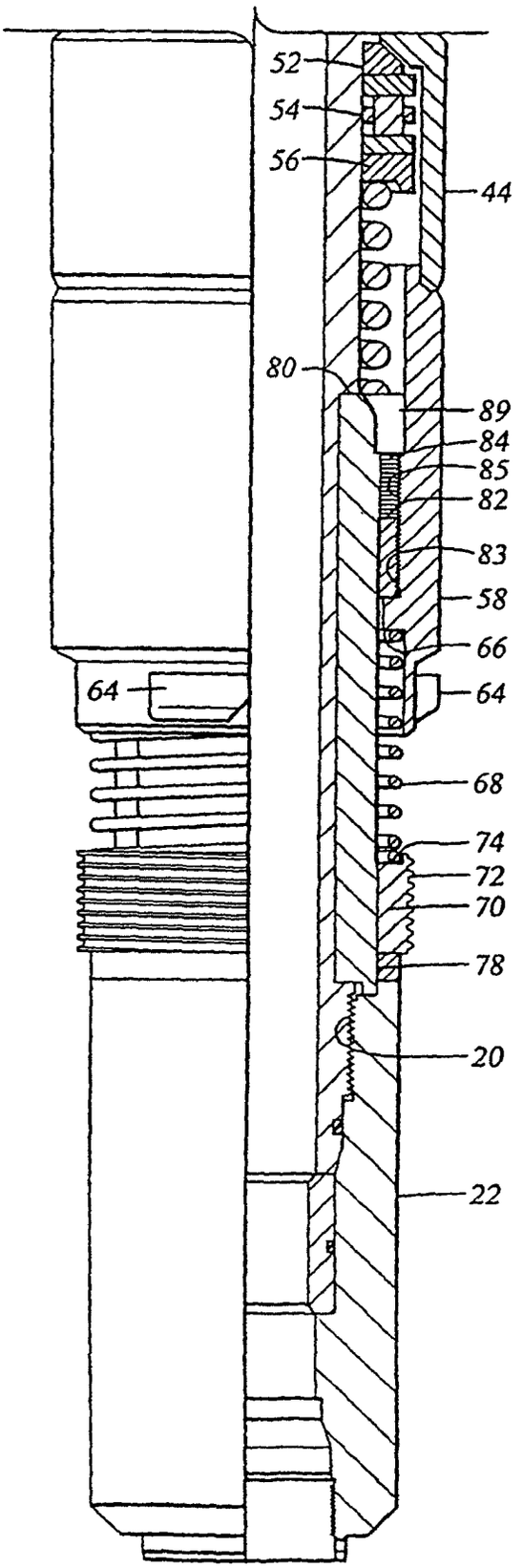


Fig. 2B
(PRIOR ART)

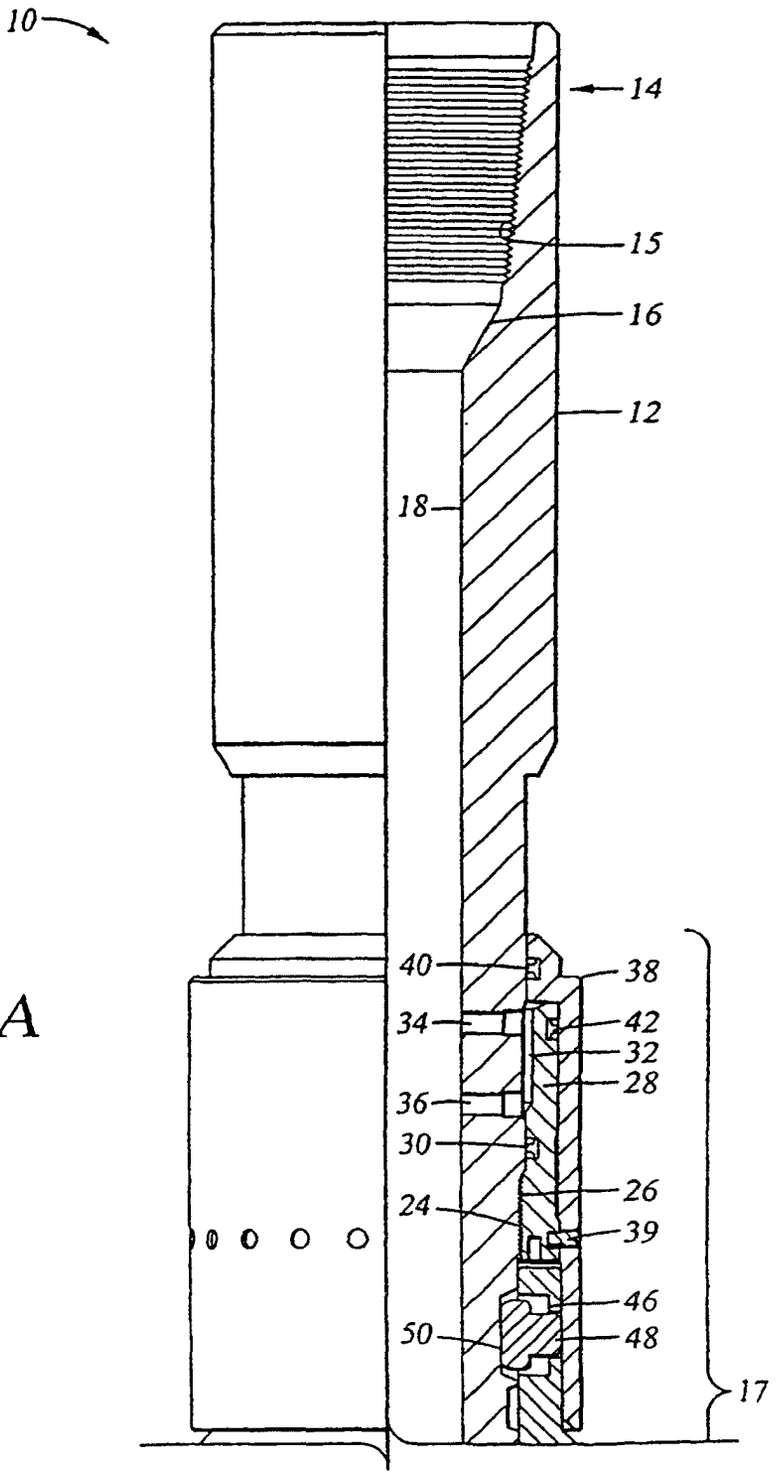


Fig. 3A

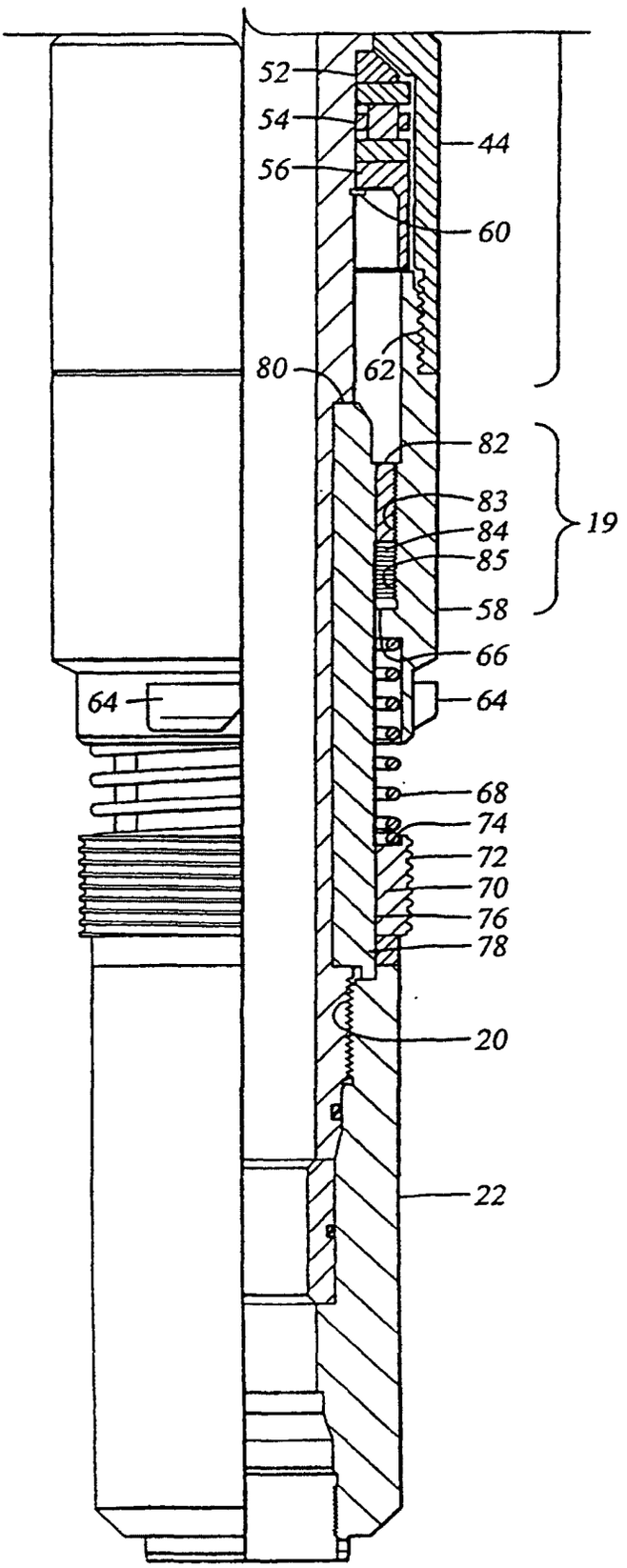


Fig. 3B

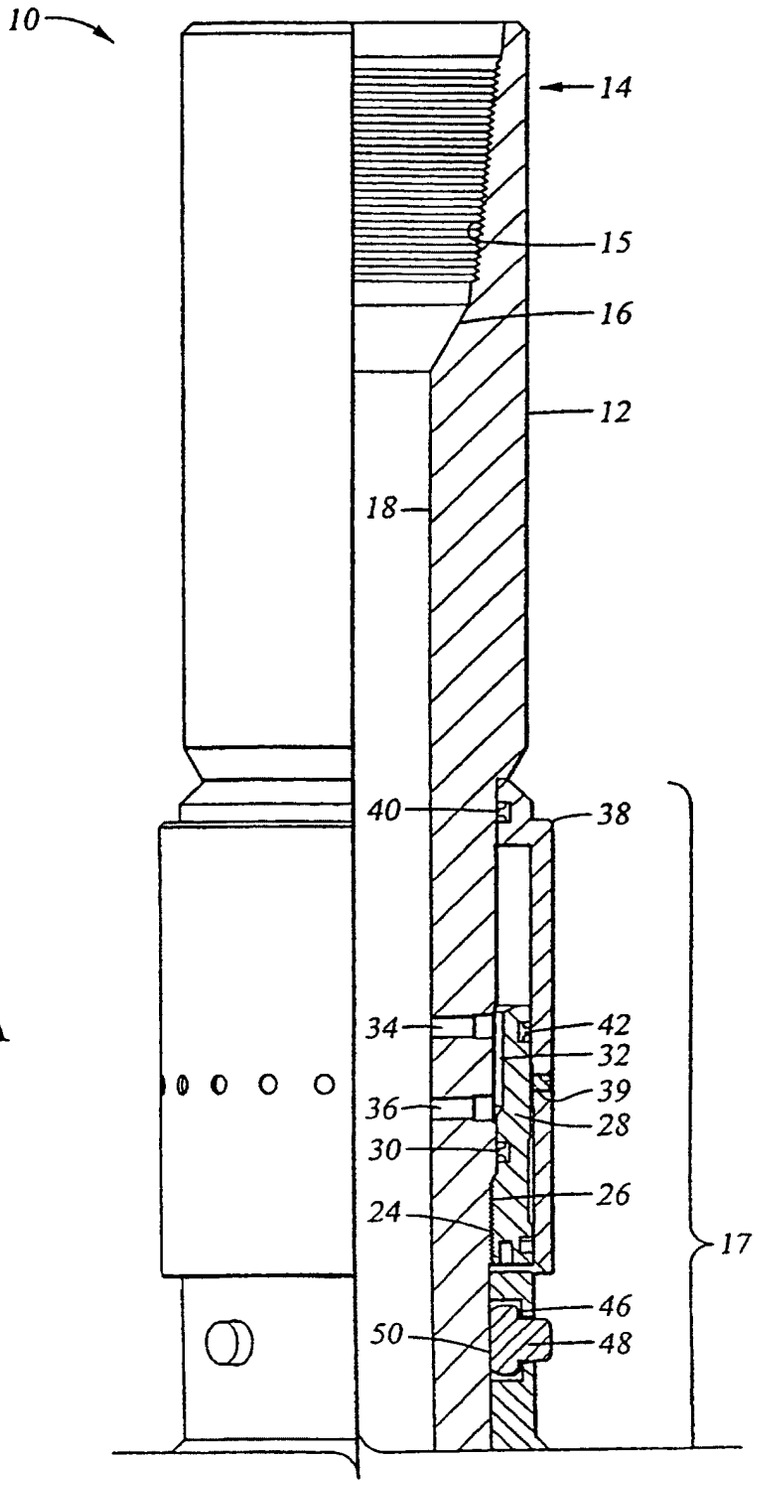


Fig. 4A

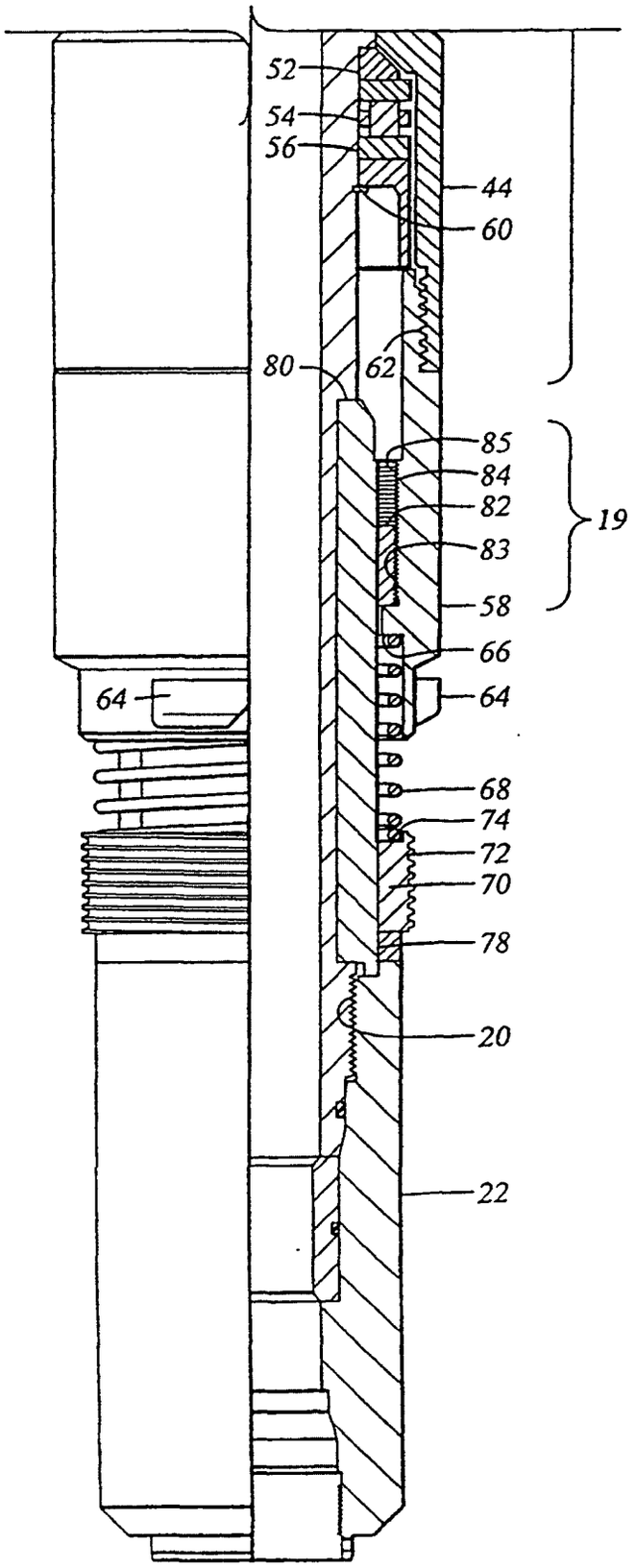


Fig. 4B

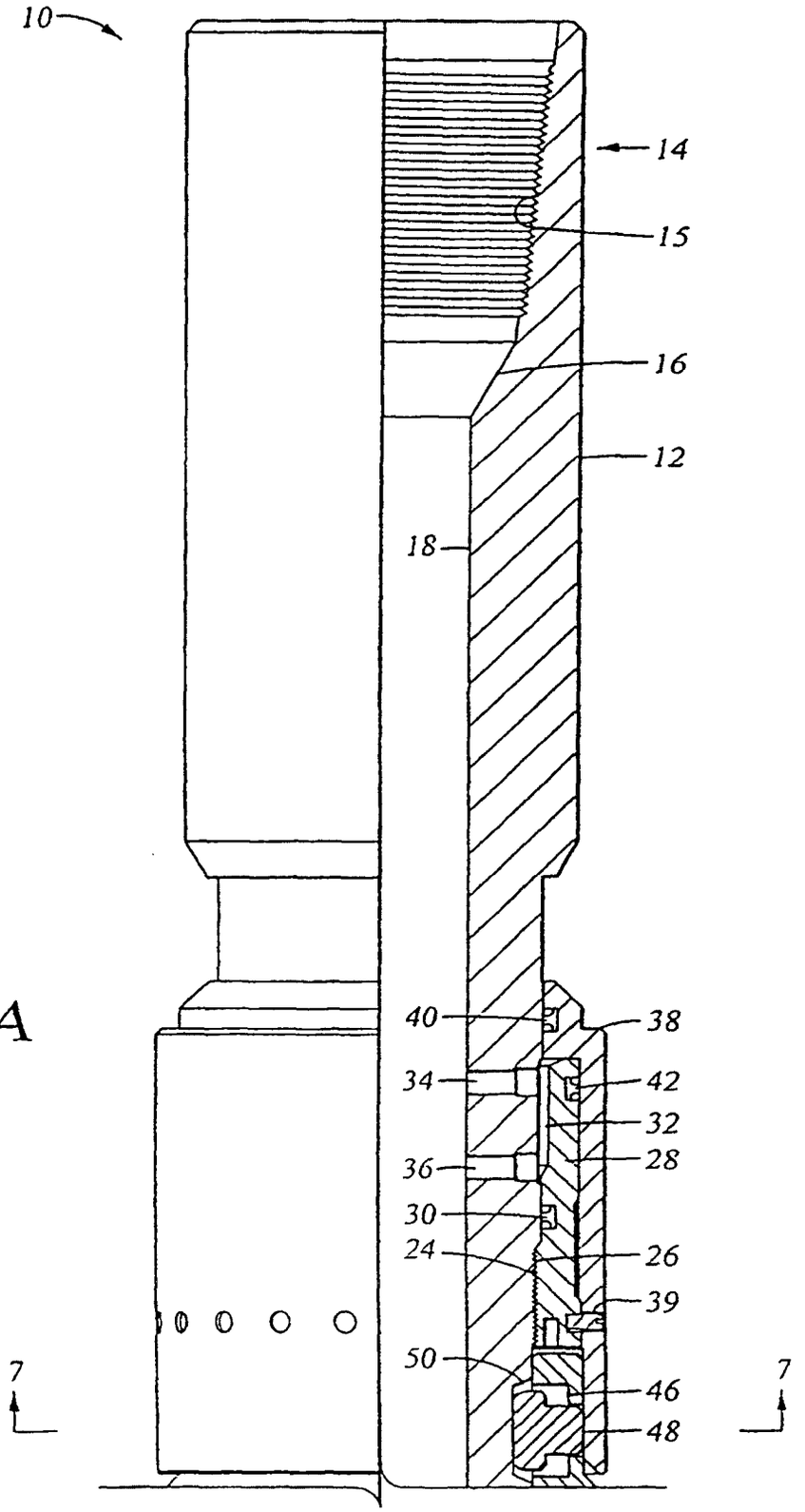


Fig. 5A

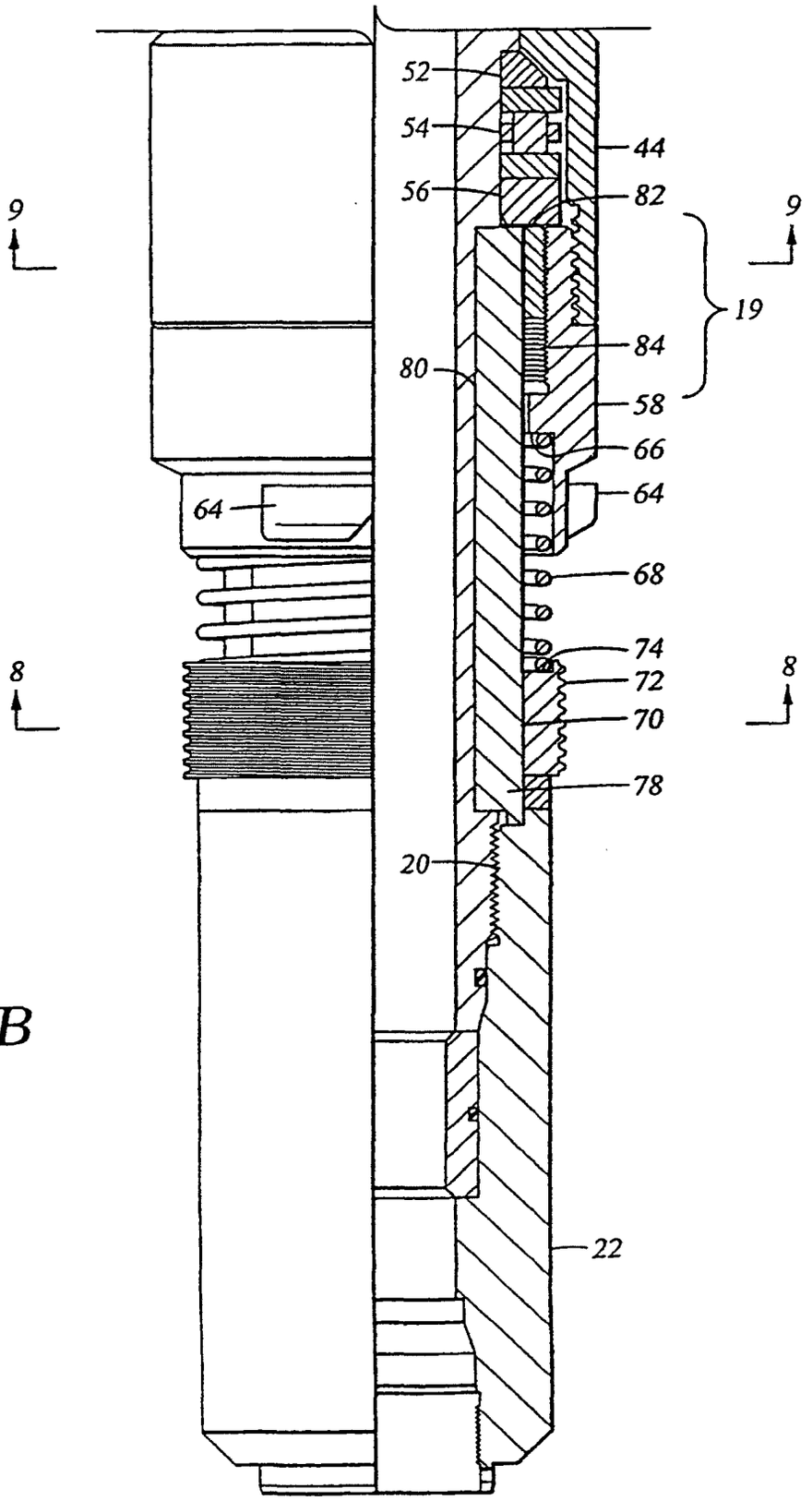


Fig. 5B

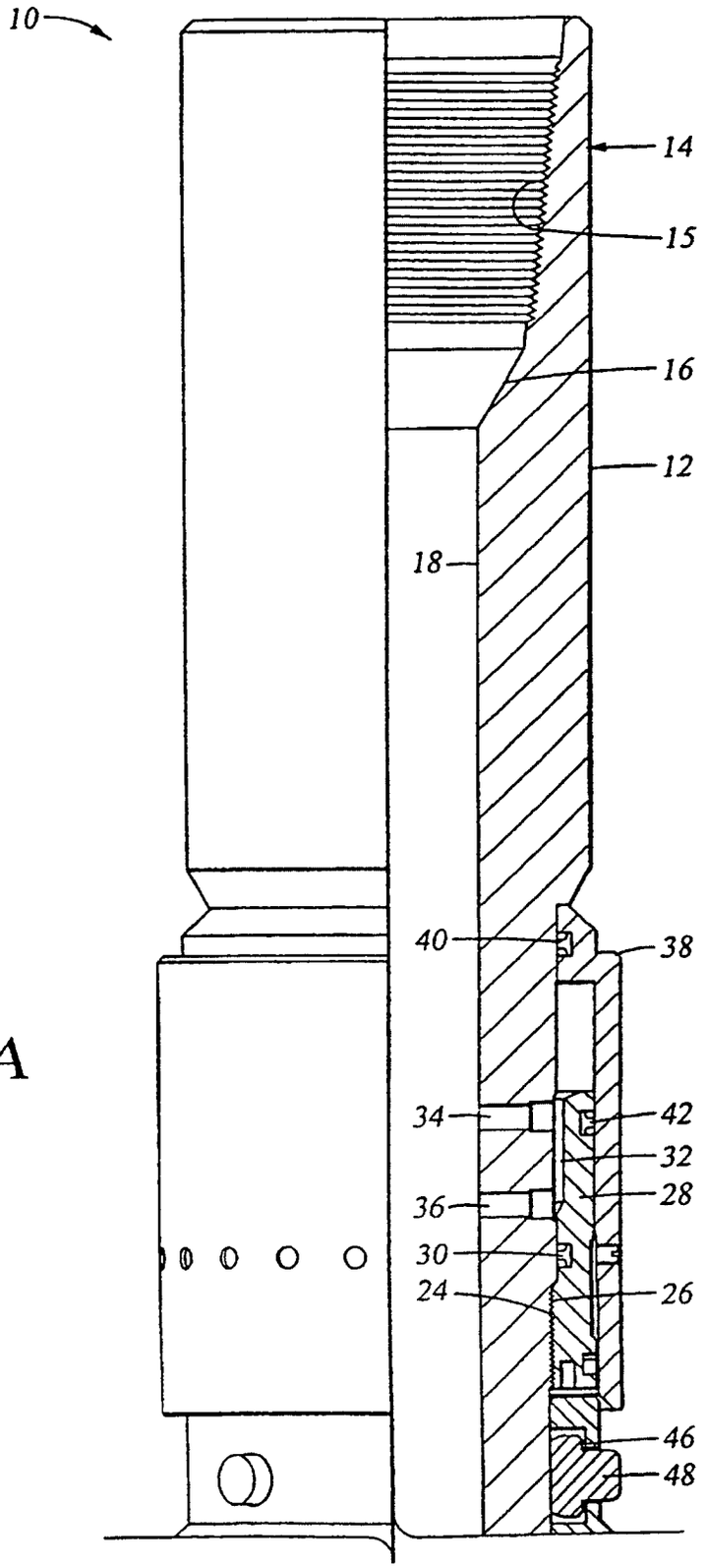


Fig. 6A

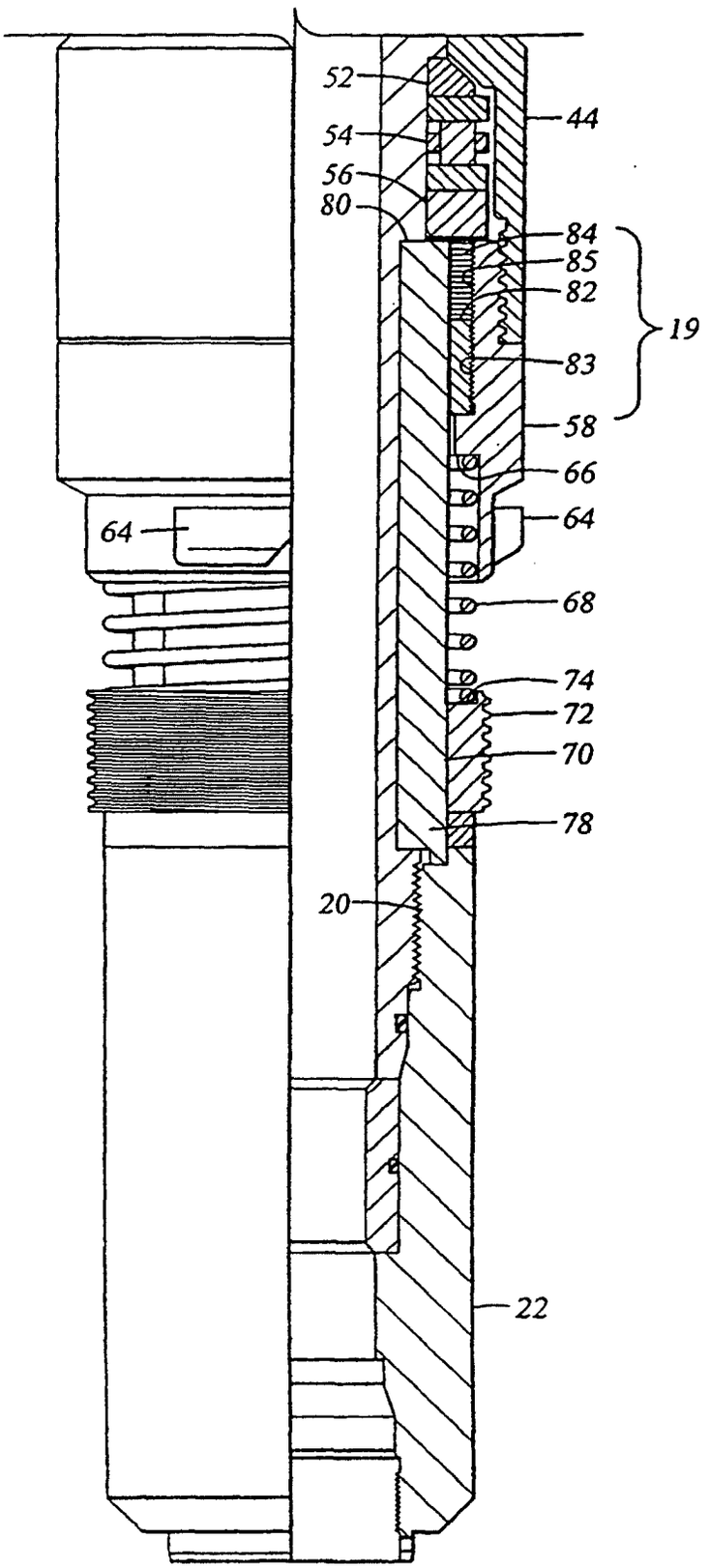


Fig. 6B

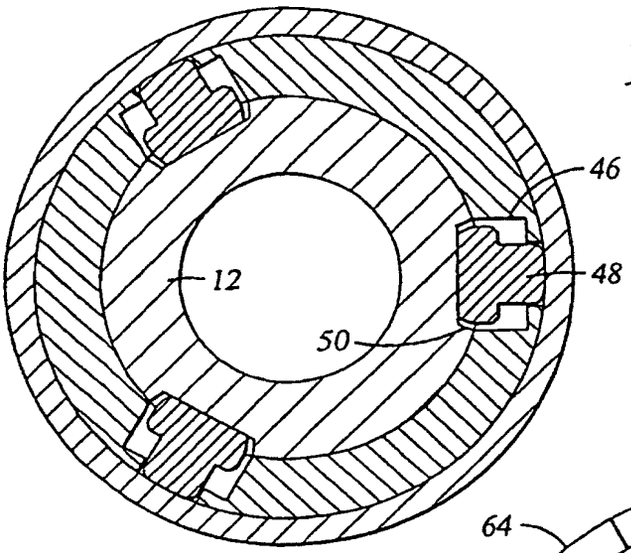


Fig. 7

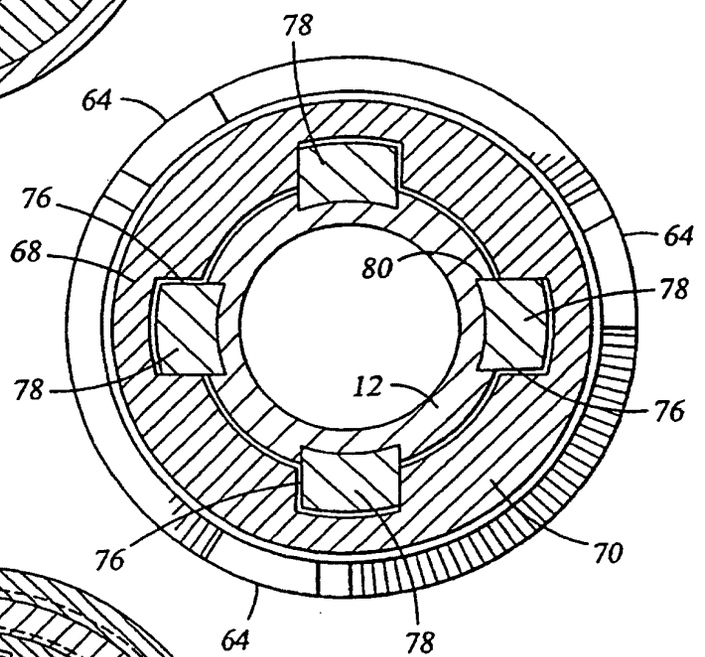


Fig. 8

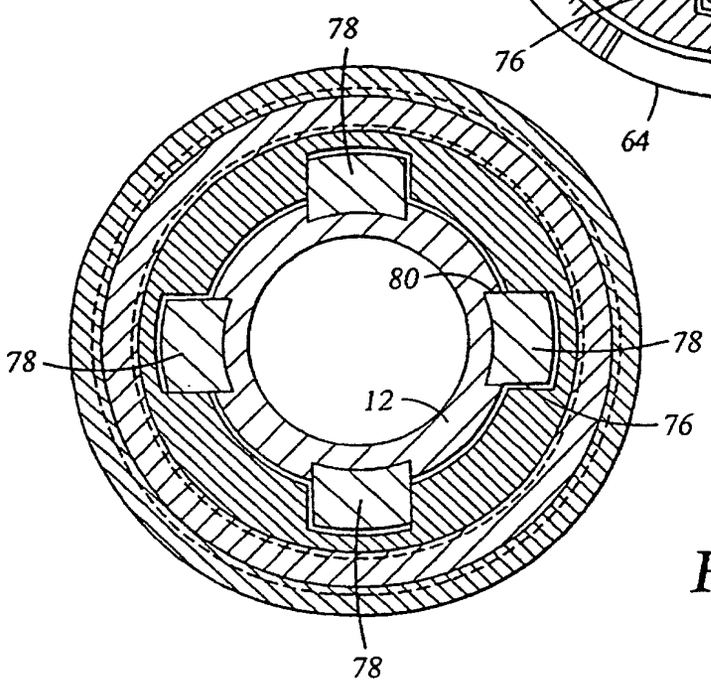


Fig. 9

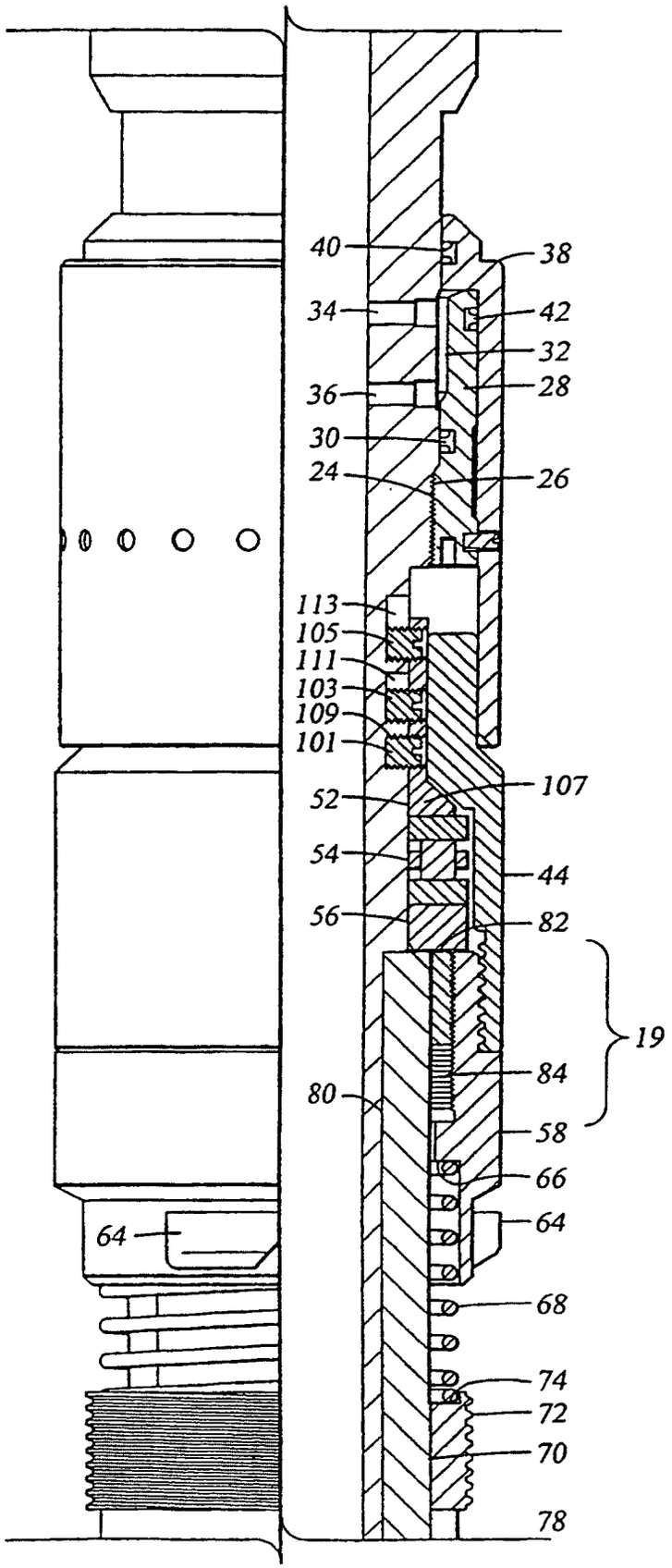

40
38
34
42
32
36
28
30
24
26
113
105
111
103
109
101
107
52
54
44
56
82
19
84
80
58
66
64
64
68
74
72
70
78

Fig. 10

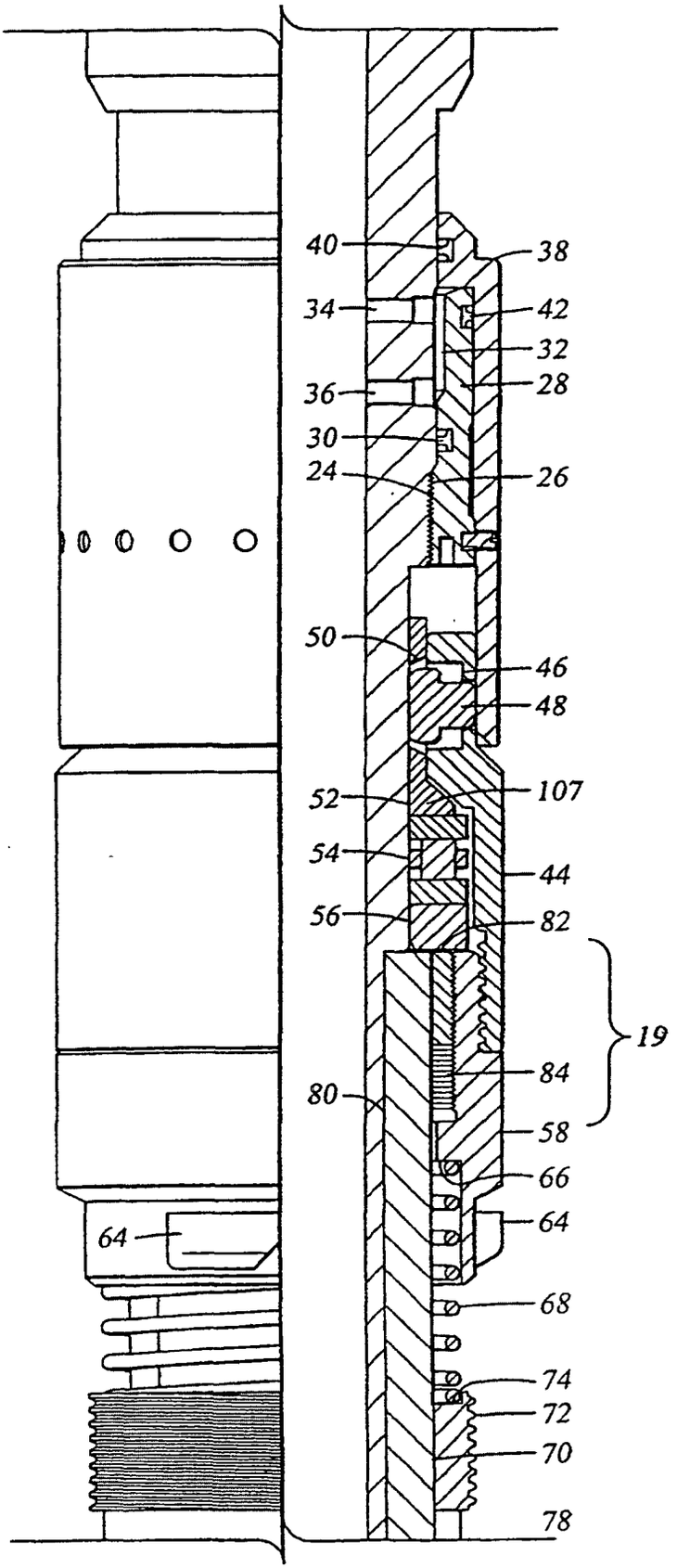

40
38
34
42
32
36
28
30
24
26
50
46
48
52
107
54
44
56
82
19
84
80
58
66
64
64
68
74
72
70
78

Fig. 11